

ART. XXIII.—*The Endoparasites of Australian Stock
and Native Fauna.*

PART II.

New and Unrecorded Species.

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(With Plate XXIX).

[Read 10th December, 1908.]

In these records, wherever the description of the species is readily obtainable in such books as those by Neumann, Law, etc., it is unnecessary to give detailed descriptions with the record, the latter being quite sufficient; but in cases where the forms are less well known or the descriptions or figures necessary for identification are not easily available here, or where points of variation or special interest are present, these details have been given somewhat more fully than would otherwise have been done, for the convenience of workers in Australia, where much of the literature of this subject is generally unobtainable.

These early records are based largely on a small store of material in the Museum of the Biological Department here: the name (where known) of the collector or donor of each set of specimens accompanies the individual record. The material to hand so far has been preserved in formalin or ordinary alcohol (70 to 90 per cent.). As I have as yet received no living material, I have not been able to try other methods recommended by various workers. Specimens preserved in formalin are, as a rule, very indifferent for histological examination. For examination in bulk, I have tried the following: oil of cloves, carbolised absolute, xylol, pure glycerine, 20 per cent. glycerine, cedar oil and caustic soda: and have found all in a measure

good. Very often, however, the reagent which makes clear one structural detail is useless for some others, so that I always examine each species in several reagents. That most commonly used for Nematodes and most generally satisfactory, especially where time is a consideration, is what I have called carbolised absolute—i.e., a mixture of 80 per cent. of pure carbolic acid and 20 per cent. of absolute alcohol, used also, I believe, by Dr. N. A. Cobb. It is unfortunate that this substance cannot be used for clearing preparatory to mounting in balsam. For purposes of measurement this carbolised absolute is more satisfactory than any other of which I know, except, perhaps, caustic soda and 20 per cent. glycerine, the two former substances retaining the full size and shape of the worm better than any of those mentioned above. In order to determine the reagent best retaining the proportions and full size of the animal, I made a series of experiments with Nematodes, with the following results. Taking the length in carbolised absolute as 100 divisions of a scale, and the width as 4.9 divisions, I found the variations to be as follow:—

Carbolised absolute	-	100 divisions	×	4.9 divisions.
Caustic soda (50%)	-	100		4.8
Glycerine (20%)	-	99		4.9
Absolute alcohol	-	96-97		4.8
Glycerine (pure)	-	95		3.7
Oil of cloves	-	94		4.9
Xylol	-	93		4
Cedar oil	-	87		3

(These reagents were not used consecutively on the same worm.)

Since evidently there is less shrinkage and distortion from the use of carbolised absolute than of the other reagents mentioned, I have made all my measurements in this fluid.

The method of description and record can be seen at a glance. In giving the synonymy, it is my purpose to give it in full wherever possible, with the original dates also, though in the early stages of this work it is not always practicable, as there is so much of the literature as yet unobtainable in Australia.

A. TREMATODES.

No. 1.—*Paramphistomum cervi*, Zed., 1790.

= *Festucaria cervi*, Zed., 1790.

= *Monostoma conicum*, Zed., 1803.

= *Amphistomum conicum*, Rud, 1809.

(v. Fischöeder, 1901, p. 368.)

Paramphistomum.—Numerous specimens. Length, 8 to 13 mm.; maximum diameter, 3 to 6 mm.; conical in shape, the mouth being at the apex of the cone. The body is occasionally reddish, otherwise cream in colour. May become easily detached from the wall of the stomach after death of the host, shortening and thickening considerably, often curling up.

Host.—Cow: reticulum and rumen.

Locality.—Wangaratta, Victoria, August, 1908; from Mr. S. S. Cameron, per Dr. Bull.

Previous Records.—From New South Wales and Queensland (v. pt. i., Census).

Remarks.—The opinion of the residents of the locality whence this material came—viz., that it causes considerable mortality in cattle, is in harmony with that of Zurn (Neumann, p. 301) and Cobb (1891, p. 614-5); but I have, as yet, no direct evidence bearing on the point. In this instance the worms were very numerous in the part of the rumen forwarded to me, averaging one to every .5 square millimetres.

B. CESTODES.

No. 1.—*Anoplocephala perfoliata*, Goeze.

= *Taenia perfoliata*, Goeze.

(v. Bronn's Cestodes, p. 1711.)

Anoplocephala.—21 specimens. Length, 15 to 24 mms.; breadth, 3 to 13 mm.; head, 2 mm. in diameter, tetrahedral and rounded with 4 dome-shaped suckers pointing forwards; prolonged posteriorly into 4 prominent rounded lobes, easily seen from anterior end. Body broad and short. Segments broad and thick, but very short anteriorly, lengthening towards the posterior end; each overlaps the one behind. The curious narrowing of the posterior segments is well seen.

Host.—Horse: ileum and caecum.

Locality.—Melbourne, Sept., 1908, per Mr. W. T. Kendall. The existence of this tapeworm has previously been recorded for N.S.W. and Queensland, and possibly for Victoria. Those brought to me represented a very large number found all along the ileum and also in the caecum of a horse which had been killed for dissection. The small intestine is not so common a habitat for this species as the caecum. Mr. Kendall states that tapeworms are "very common" in horses here, but that he has "never known them to produce any characteristic symptoms, and as they are found in nearly all old horses, he is of the opinion that they do little harm."

No. 2.—*Cysticercus pisiformis*, Zeder.

This simple cystic stage of *Taenia serrata*, Goeze, has been found in considerable numbers in the rabbits used in the Biological laboratory during 1908, and has also been sent in from numerous other localities, so that it would appear to be widespread in Victoria.

Host.—Rabbit: all parts of the peritoneum are subject to the presence of these cysts.

Locality.—General in Victoria. Per Mr. A. Hart (Freezing Works), etc.

Previously recorded for N.S.W. and Victoria (v. pt. i., Census.)

No. 3.—*Echinococcus polymorphus*, Diesing.

= *Echinococcus hominis*.

= *Echinococcus multilocularis*.

= *Echinococcus veterinorum*, Rud.

These cysts forming the asexual generation of *Taenia echinococcus*, v. Sieb., have been very prevalent in rabbits in Victoria during 1908, both those brought to the Biological Laboratory, and those used as food, a large number having been sent to me from the Freezing Works. They have been found in almost all of the organs lying in the abdominal cavity, liver, kidney, uterus, etc., in the peritoneum and also in the muscles of the body wall or limbs. The complexity and size of the cysts vary greatly with age, while the cyst wall itself may be very thin, semi-transparent and fragile, or tough and fibrous.

I have also received from the Veterinary College here the kidney of a horse deformed by two deeply-seated cysts which appear to belong to this species. It is stated by Mr. Kendall to be very rare.

Host.—Rabbit: abdominal organs generally, per Mr. Dombrain, June, 1893, and Mr. A. Hart (Freezing Works), July, 1908; horse kidney, per Mr. W. T. Kendall, Melbourne Veterinary College.

Locality.—Various in Victoria.

Previously recorded for Victoria in Man "and Lower animals" (v. part i., Census).

No. 4.—*Coenurus serialis* (?), Baill.

This is represented in this collection by one cyst, 21 mm. long and averaging 18 mm. in diameter. In the present cyst the scolices are seen to be arranged in groups along 6 nearly radial lines on the inner side of the somewhat fragile cyst-wall. The head of the scolex conforms in general with the characters of *Taenia serialis*, the hooks varying in number from 27 to 30, and in general shape resembling the typical hooks of this species. In size, however, the hooks of this specimen are much smaller in size—viz., the larger .092 mm. long, and the smaller .064 mm. (as against .135 and .085 mm. and upwards).

Host.—Rabbit.

Locality.—Victoria (?).

Taenia serialis (?) has been recorded previously from Australia but once only, by Cobb, in a dog from N.S.W. The hooks there, however, are larger than the typical ones.

C. NEMATODES.

No. 1.—*Sclerostomum edentatum*, Lss., 1901.

= *Sclerostomum equinum* (O. F. Mueller, in part) (v. Looss, '01, p. 77).

Sclerostomum.—Four specimens, all females. Lengths, 33 mm., 33 mm., 42 mm., 43.6 mm., and thickness, 1.75 mm., 2 mm., 1.75 mm. and 2 mm. respectively. The greater thickness of the head, as compared with that of the body generally,

and given by Looss as characteristic of this species, is clearly seen in these specimens. The mouth capsule is cup-shaped, and contains no teeth. The elongated triangular shape of the "dorsal gutter," as seen in transverse section exactly agrees with that described by Looss in his specific diagnosis. Oesophagus:—In length these are 1.75 mm., 1.55 mm., 1.95 mm., 1.86 mm., and in thickness, minimum .42 mm., maximum .54 mm.; minimum .39 mm., maximum .54 mm.; minimum .33 mm., maximum .48 mm.; and minimum .4 mm.; maximum .6 mm. respectively. It will be seen from this that the oesophagus is rather thinner than that quoted by Looss for *Scl. edentatum*, and about the same as that of *Scl. equinum* (s.s.) but on comparing the transparent head of these forms with Looss' figures (pl. i., fig. 11, etc.) of the two species, there is no doubt that these 4 specimens belong to *Scl. edentatum*, quite apart from other points of similarity. The same relation between the widths of oesophagus and body and the same sudden enlargements of the oesophagus behind the nerve ring, are here seen.

The excretory pore opens far forward on the head, but the cervical papillae are not visible in any one of the 4 specimens. The great thickness of the skin is especially well seen in two individuals, and in all "the slight general torsion of the body round its long axis." The female opening is, except in one specimen, curiously indistinct. In that one, the first of those named above, the vulva is still surrounded by the peculiar brown cement, and so its position, 8.25 mm. from the anus, is clearly seen. But it is very indefinite in each of the others—it appears in them to vary between 7.5 mm. and 11 mm. in front of the anus. The blunt tail of *Scl. edentatus* is seen here.

Host.—Horse: stomach (and intestines?).

Locality.—Horsham, Victoria; June, 1903.

Not previously recorded (as such) in Australia.

No. 2.—*Sclerostomum vulgare*, Lss., 1901.

= *Sclerostomum armatum*, Rudolphi, according to Poeppel
(v. Looss, '01, p. 78).

Sclerostomum.—14 females, 1 male. Lengths, male 15.6 mm., females 18 to 23 mm. (average 19.3 mm.); thickness, male .94

mm. maximum (average .75 mm.), female .8 mm. maximum (with average .75 mm.) to 1.29 mm. (with average 1 mm.). The diameter of the male is nearly constant for the whole length, while that of the female is greatest in the middle region of the body, tapering to each end, but anteriorly truncate and posteriorly pointed. No distinction in size between the head and the rest of the body. Buccal cavity cup-shaped, widest near anterior end. Dorsal gutter hemispherical and slightly grooved in transverse section. The single tooth at the base of the dorsal gutter shows the double earlike lobes typical of this species. The excretory pore and cervical papillae are rarely seen, but when visible are in the region of the nerve ring. The length of the oesophagus is—male 1.17 mm., female 1.3 to 1.76 mm. (averaging 1.5 mm.). Its maximum diameter is—male .3 mm., female .3 to .53 mm. (averaging .44 mm.) The bursa of the male exactly resembles that figured by Looss ('01, pl. ii., fig. 18). The female opening varies in position somewhat, being situated from 5.25 mm. to 7.48 mm. from the posterior extremity. As stated above, the tail is pointed, differing in this from *Sclerostomum edentatum*. From this description it may be seen that these individuals exactly agree with the description given by Looss of *Sclerostomum vulgare*, in all respects except some of the measurements, where slight differences are found. Thus in some of the females, the vulva is somewhat nearer the posterior end, in the male the length of the oesophagus is slightly less, and the maximum diameter of the oesophagus is a little greater than those quoted by Looss for *Scl. vulgare*. But these points are not by any means sufficient to invalidate this identification, in view of the great number of details in which there is a complete agreement with the diagnosis given by Looss.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria, June, 1903.

No previous record for Australia.

No. 3.—*Triodontophorus intermedius*, n. sp.

(See Plate XXIX., Figs. 1, 2, 3).

This species in some respects combines the characters of *Triodontophorus minor* and *Tr. serratus*, Looss ('01, p. 78); in

others it comes intermediate between those two species. One is tempted at first sight from some of the linear proportions to regard it as an immature form of *Tr. serratus*, but that is seen to be out of the question on examination of the reproductive organs, which are fully mature. On the whole, it is more satisfactory to separate it from that species. So far as the material in hand, consisting of three females, is concerned, its specific characters appear to be the following:—

Triodontophorus.—Length, ♀ 15.9 to 20.25 mm. (average 18.4 mm.); maximum diameter ♀ .6 to .83 mm., average diameter .48 to .66 mm., so that the body is somewhat more slender than either *Tr. minor* or *Tr. serratus*, and also more pointed both anteriorly and posteriorly. Head not usually separated from body. Mouth collar, as in *Tr. serratus*, not appreciably depressed. Parts of external leaf-crown and capsule teeth 36 to 44. Mouth capsule .12 to .15 mm. in length, and usually about .15 mm. in extreme diameter. It is therefore generally similar in shape, though not size, to that of *Tr. serratus*, but in the case of the longest specimen, which is similar to or intermediate between the remaining two individuals in other respects, the capsule was longer and narrower, as in *Tr. minor*, though differing in size from that, being .15 mm. in length, and only .11 mm. in diameter. Teeth generally .04 mm. long, as in *Tr. minor*, but showing the more serrated edge found elsewhere in *Tr. serratus*. In the longest individual—that mentioned above—the teeth were .048 mm. long, and the denticulation of their anterior edges was not so marked as in the other two individuals. Oesophagus, same general shape and average length as in *Tr. minor*; maximum diameter .16 to .21 mm., minimum .07 to .084, i.e., slightly thicker than *Tr. minor*, and less than in *Tr. serratus*. Excretory opening as in the two original species, i.e., just behind the nerve ring. The cervical papillae appear much nearer the median ventral line than in *Tr. minor* or *Tr. serratus*.

Female opening 1.32 to 1.54 mm. from tip of tail, and anus .28 to .31 mm. from tip. In each of these respects this species is intermediate between *Tr. minor* and *Tr. serratus*. In general appearance the tail more closely resembles that of *Tr. serratus* than that of *Tr. minor*.

Host.—Horse: stomach (and intestines (!)).

Locality.—Horsham, Victoria; June, 1903.

Two types in the museum of the Biological Department of the University of Melbourne.

Remarks.—The marked intermediate character of these three specimens raises a suspicion in one's mind as to the validity of the separation of the forms described as *Tr. minor*, *Tr. serratus* and *Tr. intermedius*, into distinct species. But in view of the small amount of material of *Tr. intermedius* available, and of the geographical isolation of this country, it has seemed wiser in the interests of clearness to make a new species of these three specimens, the only representatives of the genus yet known in Australia. Unfortunately the material was in a very unsuitable condition for histological examination.

No. 4.—*Cylichnostomum poculatum*, Lss., 1901.

Cylichnostomum.—1 female. Length, 9.6 mm. Head not constricted off from body; skin annulated. Mouth collar flattened, and cut off from skin. External leaf-crown has approximately 36 long, fine teeth, with tips projecting beyond mouth-collar. Submedian head-papillae long, flattened, and with tips apparently constricted; lateral head-papillae not conspicuous. Depth of mouth capsule equal to its external diameter; walls thin anteriorly but becoming thicker posteriorly. Internal leaf-crown typical, the elements being short and thick. Dorsal gutter conspicuous but short. Excretory pore and cervical papillae in region of nerve-ring. Oesophagus, length .84 mm., maximum diameter being .13 mm., and minimum diameter .078 mm. Transverse section of intestine oval, being flattened laterally. Tail long, broad at base and tapering to tip. Anus .33 mm. from tip and .156 mm. behind vulva.

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

Not previously recorded from Australia.

No. 5.—*Cylichnostomum* sp. (c.f. *poculatum*), Lss., 1901.

Associated with the specimen just described of *C. poculatum* was another individual (female) 10 mm. long, having in general

the specific characters of that species, but differing in one or two linear dimensions which vary in such a way as to make it probable that it may represent a new species not included in those described by Looss. But in view of the paucity of material, and of the fact that the head, which, however, appears to resemble that of *C. poculatum*, is badly damaged, it is wiser at present to regard this individual as a variety allied to this species. The points in which it shows a difference from the species named are as follow:—Oesophagus, length .7 mm.; distance from anus to tip of tail, .42 mm. Vulva .07 mm. in front of anus: i.e., the oesophagus is 1 mm. shorter in a longer individual of the same sex, preserved together and apparently of similar condition of maturity; the tail also is .12 mm. longer than the longest recorded of the original species, while the distance between anus and vulva is only two-fifths of that of *C. poculatum*. These variations do not appear attributable to distortion during preservation, since Nos. 4 and 5 have been preserved together throughout, or to individual variations of any kind, since they do not show any conformity with each other.

Host.—Horse: stomach (and intestines (!)).

Locality.—Horsham, Vic.; June, 1903.

Not previously recorded from Australia.

No. 6.—*Cylichnostomum* sp.

Another of this series of specimens is a small agamous *Cylichnostome*, which, I believe, belongs to *C. poculatum*, but which is hard to determine owing to the much contracted condition of the head region, and the absence of reproductive organs and opening. The chief determinable features of specific value are as follow:—Length of worm 4.8 mm., extreme diameter .18 mm. Length of mouth capsule equal to greatest diameter. Walls thin anteriorly, becoming thicker posteriorly, curved to form a much swollen cylinder. Dorsal gutter short. Oesophagus, length .276 mm., maximum diameter .036 mm., minimum diameter .024 mm. The intestine is abnormal in showing no sign of pigmentation. Anus .12 mm. from tip of tail, which tapers from the somewhat broad base to the tip. No reproductive organs or openings are present.

Until further material is available for comparison, I prefer to regard this as of indetermined species, but probably a small agamous *Cylichnostomum poculatum*.

Host.—Horse: stomach (and intestines (!)).

Locality.—Horsham, Victoria; June, 1903.

No. 7.—*Cylichnostomum calicatum*, Lss., 1901.

The last of this series of specimens consist of 4 individuals of *Cylichnostomum*, 3 males and 1 female. Length of males 5.52 to 6.06 mm., extreme thickness .21 mm.; female 6.06 mm. long and .24 mm. maximum diameter. Head slightly tapering anteriorly, but not constricted off from body. Mouth collar slightly flattened, but less so than in *C. poculatum*, set off from rest of head. External leaf-crown consists of 8 to 10 broad parts with rounded tips, which project slightly beyond mouth collar. Submedian head papillae long, with broad bases and tips constricted off. Lateral papillae small. Mouth capsule as long as it is wide, cylindrical, with almost straight walls, which are thicker than in *C. poculatum*. The elements of the leaf-crown are short and stout, and project from the anterior margin of the mouth capsule. The dorsal gutter is very long and generally seen projecting nearly to the anterior margin of the buccal capsule. The cervical papillae in one case were between the nerve-ring and excretory pore, as is typical, otherwise all three organs were nearly in the same place. Oesophagus.—This is somewhat disproportionately shorter than the original description gives, viz., .33 mm. in the male and .34 mm. in the female, but the ring-like enlargement of its anterior end is well seen. The maximum thickness of the oesophagus varies from .06 mm. in the male to .078 mm. in the females, its minimum thickness being .03 mm. in the male, and .042 mm. in the females.

The characters of the bursa in the male show no marked difference from the figure given by Looss [loc. cit., pl. ix., fig. 117], while all the characters of the head end are in complete agreement with both original description and figures. The tail of the female is very short (.06 mm.), pointed, and cut off abruptly from the body. Distance of vulva from anus .07 mm. (i.e., shorter in these worms proportionately to their shorter length).

Host.—Horse: stomach (and intestines (?)).

Locality.—Horsham, Victoria; June, 1903.

No previous record for Australia.

It is worthy of note that all the Nematode species recorded here, up to this point, were obtained together from the one horse, and of course may have been accompanied by others—certainly a most varied fauna in comparison with its small total number—viz., 3 genera, 5 definite species and two others indefinite, in a total of 29 individuals. It will be noticed that the habitat given for all these preceding forms differs from that given by Looss—thus all the species of *Sclerostomum* and *Cylichnostomum*, and *Triodontophorus serratus* are found normally in the caecum, and the 1st third of the large loop of the colon, *Tr. minor*, living in the last part of the colon. Here, however, the information accompanying the material is “stomach (and intestines (?)) of horse.” Also as regards *Triodontophorus*, Looss remarks that the individuals are “very constantly found firmly fixed to the mucous membrane of the host’s intestine.” Whether any of my specimens were so attached when found, I am unable to say, all the specimens on which these records (Nematodes Nos. 1-7) being preserved free in a glass tube, and unaccompanied by any information on this point.

No. 8.—*Ascaris megalcephala*, Cloq:

= *Ascaris equorum*, Goeze.

Fifty-one specimens of this common species of other countries were brought to me from the intestines of a horse. Their length varied from 17-23 cm., their diameter from 4-7 mm. The males and females were in nearly equal numbers. Owing to their having been kept for some time before reaching me, they showed a tendency to contract greatly on being put into formalin and spirit, the body walls shrinking away in many cases from the cuticle. The head end, unlike the tail, did not leave the cuticle, but became sharply bent ventrally, so that often the mouth was directed posteriorly instead of anteriorly. The general characteristics of these specimens are normal. A number of individuals have been picked up in various parts.

One of these, a female, was only $14\frac{1}{2}$ cm. long and 4 mm. in diameter; another female found in the scrub in Tasmania was 37 cm. long and 10 mm. in extreme diameter, while the third, a male picked up near the horse-market in Parkville, Victoria, was 27 cm. long and 8 mm. in diameter. The female opening in all cases was almost exactly $\frac{1}{4}$ of the body length from the anterior end.

Host.—Horse: intestines.

Locality.—Abattoirs, Newmarket, July, '08, per Mr. J. Robertson; Camberwell, Vic., 1904, and Parkville, Vic., 1904, and Tasmania, 1905.

Previously recorded from South Australia, New South Wales, and Bismarck Archipelago, and probably Victoria (see Part I. Census).

No. 9.—*Ascaris lumbricoides*, L., 1758.

This common parasite of man is represented in this collection by 18 worms, chiefly female, sent from the Children's Hospital. The specimens are normal in character, except that some apparently immature are below the usual size. The males vary from 10 to 14 cm. in length, and 3 to 5 mm. in diameter; the females from $13\frac{1}{2}$ to 30 cm. in length and 4 to 6 mm. in diameter. The teeth and sense papillae on the oral lips are not at all easily seen, though they can be detected in a few cases. The female opening is situated typically at one-third the body length from the anterior end. The tail of the male tends to coil ventrally in a vertical plane. The two spicula are equal in length and similar in shape.

Host.—Child: no details of habitat are given, but presumably the worms were found, as usual, in the small intestine.

Locality.—Melbourne, 1897, per Dr. Officer.

No previous definite record for Australia, though doubtless well known.

No. 10.—*Ascaris canis*, Werner, 1782.

= *Lumbricus canis*, Werner, 1782.

= *Ascaris teres*, Goeze, 1782.

= *Ascaris cati et caniculæ*, Schrank, 1788.

- = *Ascaris canis et felis*, Gmelin, 1789.
- = *Ascaris tricuspидata et felis*, Brugière, 1791.
- = *Ascaris wernerii*, Rudolphi, 1793.
- = *Fusaria mystax*, Zeder, 1800.
- = *Ascaris marginata et mystax*, Rud., 1802.
- = *Ascaris alata*, Bellingham, 1839.
- (v. Braun, '06, p. 336.)

Sixty-five specimens, forty female, twenty-five male. These are distinctly reddish in tint. The females vary in length from $7\frac{1}{2}$ to $10\frac{1}{2}$ cm., and the males from 5 to $8\frac{1}{2}$ cm. The head of both sexes shows the characteristic curve, the tail of the male being curved in $1\frac{1}{2}$ turns or less. The membranous wings on either side of the head are very conspicuous in some specimens and may have crinkled edges when large. The membranous wings on the tail are not very marked. In addition I have two specimens from a cat, one a male, measuring 5.5 cm., the other a female 9 cm. long. These are creamy white in colour.

Host.—Dog and cat: intestine.

Locality.—Not known, Victoria probably.

Previously recorded only as *Ascaris mystax*, from cat, New South Wales (v. Part I., Census).

No. 11.—*Ascaris marina* (Linn.). (Immature).

- = *Gordius marinus*, Linnæus, 1766.
- = *Cucullanus salaris*, Goeze, 1782 (?).
- = *Gordius harengum*, Bloch, 1782.
- = *Cucullanus lacustris*, var. *salaris*, Gmelin, 1788.
- = *Ascaris marina*, Gmelin, 1788-1793.
- = *Ascaris halecis*, Gmelin, 1788-1793.
- = *Cucullanus halecis*, Fabricius, 1794.
- = *Filaria marina*, Rathke, 1799.
- = *Ascaris capsularia*, Rud., 1801 (pt. i., etc.).
- = *Filaria capsularia*, Rud., 1801 (pt. ii. and iii., etc.).
- = *Spiroptera hominis*, Rud., 1801 (?).
- = *Capsularia halecis*, Zeder, 1803 and 1820
- = *Capsularia trinodosa*, Zeder, 1803.

- = *Fusaria marina*, Zeder, 1803.
 - = *Filaria piscium*, Rud., 1808-1810, etc.
 - = *Capsularia salaris*, Zeder, 1820.
 - = *Strongylus gigus* (young), Bremser, 1824 (?)
 - = *Spiroptera rudolphi*, Delle Chiaje, 1825 (?)
 - = *Filocapsularia*, Deslongchamps, 1791 to 1827.
 - = *Agamonema piscium*, Diesing, 1850-1.
 - = *Agamonema capsularia*, Diesing, 1850-1.
 - = *Filaria* (?) *marina*, Baird, 1853.
- (see pl. XXIX., figs. 4, 5, 6, 7).

The specimens on which this record and description are based were forwarded to me by Dr. A. A. Brown, of the Victorian Department of Agriculture, through the courtesy of Mr. S. S. Cameron, Chief Veterinary Officer for Victoria. These Nematodes, which Dr. Brown has named in the daily press "*Strongylus spiralis piscium*," are apparently very prevalent in Victorian fish, being found in the peritoneum. The mass (12 by 20 mm.) in my possession, which was taken from Barracouta, consists of approximately 60 worms, each individual tightly coiled in a flat spiral about 3 mm. in diameter, and having $2\frac{1}{2}$ to $3\frac{1}{2}$ coils, these coils being arranged in 3 to 5 layers thick. They are whitish in colour and opaque. Surrounding each is a somewhat loose covering, and the mass is bound together by a tough fibrous capsule, which encloses each, and makes it a matter of considerable difficulty to separate them from one another, especially as the rigidity of the body causes the worm to break rather than uncoil. As stated above, each is enclosed in a loose, slightly wrinkled cuticle-like investment which can be, with care, drawn straight off from the anterior or posterior end of the contained animal like a glove finger, leaving the entire animal behind; also, the main features of the animal can be seen through this membrane, which assumes the external shape of the enclosed worm.

The several dimensions of the body of three typical individuals are as follow :—

	A	B	C
	mm.	mm.	mm.
Length - - - - -	27	30	25
Diameter of head - - -	.144	.12	.12
" " 1 mm. back -	.3	.24	.24
Maximum diameter of body (near middle . - - - - -	.399	.45	.43
Length of œsophagus - - -	2.34	2.46	2.46
Length of intestinal diverticulum	.693	.66	.72
Diameter of body, 1 mm. from posterior end - - - -	.339	.312	.255
Diameter at anal aperture - -	.05	.099	.12
Tail (anus to tip) length - -	.078	.078	.102

The body tapers both anteriorly and posteriorly, but more gradually anteriorly. The head end is also often less sharply coiled than the remainder of the body. The tail is short and conical, the extreme tip being mucronate with transverse ridges. The body has regular and fine transverse striations. On the head one can occasionally make out a more or less rudimentary division into 3 lips, which, however, is often quite obscure. Only rarely are head papillae visible, but on the anterior face of the head is a minute conical spine with spreading base, resembling in outline that of the spine on a placoid fish scale, the obtuse apex being directed outwards. No alae are to be seen as a rule (though one specimen has one .033 mm. in width, the tail of this form being short), nor postanal nor preanal papillae.

In the three specimens of which the sizes are given above. A with a short tail has no papillae and very indistinct lips. B, also with a short tail, has 3 distinct lips and rudimentary papillae, C with a long tail has no papillae and fairly distinct lips.

A well-marked diverticulum passes forwards from the intestine where it joins the constricted œsophagus, and lies alongside the latter. The diameter of this diverticulum is greater than that of the intestine itself, and completely hides the œsophagus from view where it is present. No reproductive organs could be detected. I have been unable to find any pearl-like concretion

in the middle of the coiled animal, such as that described and figured by J. Johnstone from the gurnard (1905, p. 297). On reference to the work of Cobbold, Leidy and others, especially that of Prof. Linton (U.S.A.), it is evident that these encysted nematodes are very closely allied to, if not the same species as, those found "encysted and encapsuled" in the peritoneum in such fish as herring, mackerel, cod, salmon and shad, in the Northern Hemisphere. The cuticular covering described above is the embryonic cuticle in which these worms are still enclosed, the enclosed worm being apparently an immature *Ascaris*, the jaws, etc., of which are insufficiently developed to allow of exact specific determination. The varying stages of development found in the mass at my disposal resemble closely those found by Linton in different fishes, in (loc. cit., 1901), pl. x., fig. 115; pl. xi., figs. 121, 127; pl. xii., figs. 132, 143; pl. xiii., figs. 148, 162, 163; pl. xiv., figs. 168, 179, 181, the most characteristic resembling figs. 143, 162, 163, 168, 179 and 181, from a number of different fishes. I have found, also, that the same individual will give a different appearance of developmental stage of the anterior end according to the clearing reagent used. Those drawn by myself were cleared in carbolised absolute. As it is unlikely that the young of different species would be so closely and similarly intertwined with each other, it seems highly probable that some at least of Linton's "*Ascaris* spp. immature" will be found to be different stages of the same species.

Now as to the name to be applied to these forms. In the British Museum Catalogue of Entozoa (1853) are records and synonyms by Dr. Baird of 2 Nematodes found in the peritoneum of fish—viz.:—

- Filaria* (1) *marina* (page 7).
- = *Gordius marinus*, Linnæus, etc.
- = *Gordius harengum*, Bloch.
- = *Ascaris marina*, Gmelin.
- = *Ascaris halecis*, Gmelin.
- = *Cucullanus halecis*, Fabricius.
- = *Capsularia halecis*, Zeder.
- = *Fusaria marina*, Zeder.
- = *Filaria marina*, Rathke.
- = *Filaria capsularia*, Rüdolphi, etc.

= *Filaria piscium*, Rudolphi, etc.

= *Filocapsularia*, Deslongchamps,

from peritoneum of shad, etc.

And, on page 22, *Ascaris capsularia*,

= *Cucullanus salaris*, Goeze.

= *Cucullanus lacustris*, v. *salaris*, Gmelin.

= *Capsularia salaris*, Zeder.

= *Ascaris capsularia*, Rudolphi, etc.

= *Capsularia trinodosa*, Zeder,

from abdominal organs and peritoneum (!) of Coryphene.

Leidy in his Synopsis of Entozoa (1856, p. 42-58) gives *Agamonema capsularia* (!), Diesing, as found, as well as in the intestines, "coiled in sacs of peritoneum" of shad, herring, etc., and having as characteristics, "Body slender, most narrowed anteriorly, mouth small, circular, surrounded by an undivided lip. Tail short, obtusely conical, minutely mucronate, etc."—a description which closely fits the less developed of my forms.

In Cobbold's "Entozoa," p. 406, we find:—

= *Spiroptera hominis*, Rud., Owen, Duj. and others.

= *Spiroptera rudolphi*, Delle Chiaje.

= *Strongylus gigas* (young of), Bremser.

= *Filaria piscium*, Rud., Siebold, Schneider, etc.

= *Gordius marinus*, Linnæus.

= *Agamonema piscium*, Diesing.

with the cod and haddock as hosts (and, doubtfully, man); the description given by Schneider of this form ('62, p. 302) being "Asexual nematoid in abdominal cavity, and among the muscles of several marine fishes," and having 3 indistinct labial lobes, one of which supports a tooth, "the oesophagus having posteriorly a caecal prolongation." This agrees with some of my specimens, as regards the head at all events.

Cobbold (1865, p. 325) further records the finding of *Filaria capsularia* on liver of hemp fish, in Manchester.

Leidy (1878, p. 171) mentions *Filaria capsularia*, Rudolphi, as a synonym of *Agamonema capsularia*, Diesing—found in Europe in the herring, mackerel, cod, salmon, etc., and in America in shad and herring.

In 1888 we find a record by Linton (p. 454) of *Agamonema capsularia*, Diesing, "encysted and encapsuled in peritoneum," especially in *Lophius*, sp.

In 1888, also, Leidy (1888,¹ p. 166-168) adds the Rock fish to the list of hosts of *Agamonema capsularia*. In the same year, Leidy (1888,² p. 211-217) gave *Agamonema capsularia*, Diesing, as a synonym for *Gordius marinus*, Linnaeus, which he finds encysted in peritoneum around the stomach and intestines, etc., often forming "flat and close spiral coils on viscera or appended to them." In this same paper he gives the *Agamonema* of the Herring as differing in several details from that of the shad—and according to his description neither of these exactly resembles the specimens herein described.

These encapsuled and immature Nematodes have been dealt with still more fully since that date by Linton. Thus in 1895 (p. 111) he says:—"I have been able to refer some of them to species described by Leidy and others. Some agree superficially with *Agamonema communis*, for example, but upon closer examination will be found to be covered by a thin investment which itself bears the distinguishing characters of *Agamonema*, while within this investment is a nematode which is plainly an immature *Ascaris*." This, as may be seen on comparison with the description of these Victorian forms, is exactly what I have found here. Linton continues: "Specifically identical forms may be encysted in the body cavity, and free in the intestine of the same fish." *Ascaris capsularia* is also recorded by Zschokke (p. 775) as present in *Salmo salsar* (peritoneum). In a later Bulletin (1899, pp. 267, 407, etc.), Linton states in addition that these young Ascarids are too doubtful in specific characters to enable one to give them specific names, as the individuals in the same host, at the same time and place, may differ considerably from one another. That also is true of my specimens. *Agamonema capsularia* and *Ascaris capsularia* are definitely accepted as synonyms by Linton (1901, p. 444) when considering the numerous parasites found in the fishes of the Woods Holl Region. This makes the chain of synonymy complete, as given at the head of this section. Thus, according to Dr. Baird and Cobbold, *Gordius marinus*, Linn. = *Filaria piscium*, Rud., each of these being synonyms of *Filaria*

capsularia, Rud. (v. Dr. Baird). Leidy gives *Filaria capsularia*, Rud. = *Agamonema capsularia*, Dies., and *Gordius marinus*, Linn. = *Agamonema capsularia*, Dies.; while Linton, in giving *Agamonema capsularia*, Dies. = *Ascaris capsularia*, Rud., links on the synonyms of *Ascaris capsularia*, Rud. Numerous other references have been consulted in this connection, but as they simply corroborate what has been given above, and add nothing fresh to the discussion, I have omitted them. It would thus appear that the name for this admittedly indefinite species should be *Ascaris marina* (Linn.), and as I have not been able to discover any reason why Linnæus' species has been rejected, especially by Leidy (who calls attention to its synonymy), I have used this as being the more correct name, in preference to the commonly accepted name, *Ascaris capsularia*, Rud.

Possibly there has been a confusion of a number of species very closely related in general appearance and habit. Linton only regards them as *Ascaris* species, their immaturity and the variability they display even where the differing specimens are almost certainly of one species, rendering it difficult to distinguish them specifically. Much of this variability is doubtless simply due to difference in the stage of development, so that the number of adult species represented by these varying forms will be very much less than appears at first sight when examining them.

As the early descriptions given by Leidy of *Agamonema capsularia*, Dies. (*Gordius marinus*, L.) so closely agree with the forms in my possession, it seems justifiable to designate them *Ascaris marina*, Linn., even in the light of the possibility of several species being confused under one specific name, and the impossibility of my being able to determine at present the exact original form described under the specific name of *marinus*. At the best, the name is one given to an immature Ascarid.

Host.—Barracouta.

Locality.—Port Phillip, Victoria; Nov., 1908.

No previous record from Australia.

No. 12.—*Gongylonema scutatum*, Leuckart, 1876.

There has come into my hands from Mr. Robertson, Government Veterinary Surgeon, per Mr. S. S. Cameron, a bottle containing "Portion of Rumen of Cow, worm attached, Sept., '98," and bearing an additional label with the following note:—" *Gongylonema scutatum* (Leuckart, 1876), natural habitat oesophagus—no previous record as being in Rumen (Neumann, '98)," this specimen having been identified by Neumann in 1898. As I have been unable to find any record of the occurrence of this worm in Australia, I am including it here.

There are 2 specimens, both females, one unattached being 12 cm. long, the other, of which the anterior part is embedded in the wall of the rumen, has an exposed length of 7 cm. The cuticular plates around the otherwise unarmed head end are very well marked, varying considerably in size. The tubular pharynx .55 mm. long, is succeeded by an oesophagus 8.8 mm. long, the posterior end of the latter having a club-shaped swelling .26 mm. in diameter.

The posterior portion of the body is closely packed with ova.
Host.—Cow: rumen.

Locality.—Victoria; Sept., 1898.

No previous record from Australia.

- D. NEMATOMORPHA.
- E. ACANTHOCEPHALA.
- F. INSECTA.
- G. ARACHNIDA.

No. 1.—*Hypopial* nympha of *Falculifer rostratus* (?)

(Buchholz, 1869), Railliet, 1896.

- = *Falciger rostratus*, Buchholz, 1869.
- = *Hypodectes columbar*, Solarski, 1877.
- = *Hypoderas columbae*, Murray, 1877.
- = *Hypodectes minor* (?).

(see pl. XXIX., figs. 8, 9).

During the dissection of pigeons in the Biological Laboratory here, a number of small organisms were found in the connective

tissue around the roots of the pectoral blood-vessels and in the pericardium by Dr. T. S. Hall, who brought them to me. Careful examination of them and consultation of such literature as was available to me, showed that these forms are really the "hypopial nymphæ," or second stage in the life-history of one of the feather-feeding Sarcoptidae, probably of *Falculifer rostratus* (Buchholz, 1869), Railliet, 1896.

This and similar forms—known variously as *Acarus muscarus*, Linn., *Acarus spinitarsus*, Hermann, 1757, then *Hypopus*, Duges, 1834; *Homopus*, Koch, 1843, and later as *Hypodectes*, Filippi, 1861, and *Hypoderas*, Frauenfeld, 1864—have been the subjects of a long discussion, dating from 1735, but closed for the time being by the work of Mègnin (1879, p. 120) and that of Michael (1884, p. 371).

These parasites, as previously described by several—viz., Michael, and also figured by Ch. Robertson (1866, p. 201)—are white, elongated, rounded animals, maggot-like in general appearance, .92 to 1.24 mm. long, and .16 to .31 mm. wide. The skin is soft and easily wrinkles. No median transverse groove was visible, nor were rostrum, mouth appendages or alimentary canal to be seen. Four pairs of short jointed legs are present, the two posterior pairs being situated a considerable distance behind the 2 anterior pairs. Each leg has 5 joints, not always clearly defined, the last bearing a number of hairs, one or more of these hairs being much longer than the others. The bases of the two anterior pairs of legs are associated with a curious darkly coloured chitinous-like support on the ventral surface of the head, while another similarly constituted but differently arranged structure is found on the ventral surface of the body, between the 2 posterior pairs of legs. These two masses form a most conspicuous and characteristic feature in the appearance of the parasite. The form here recorded is closely similar to that figured by Robertson, but I am adding hereto two figures, one of the dorsal surface of the head, and one of the ventral surface of the body, for comparison. As I have not the adult stage of this form, I have not been able to completely verify this identification.

According to Mègnin's researches (loc. cit., and see also Neumann, p. 214), this much reduced form is a peculiar stage

in the life-history of the itch-mite of the pigeon. There is found in this case, a deviation from the normal metamorphosis, inasmuch as this additional stage, or "hypopial nymph" is introduced between the second stage or normal "nymph" and the young adult. The "hypopial nymph" is formed from the normal "nymph," according to Mégnin, under conditions in which there is an undue lack of nourishment or warmth in the feathers on which the adult lives. The "hypopial nymph" then passes down from the surface of the body through the feather follicles into the connective tissues below, where it lives by absorption from the surrounding tissues until such time as it may safely return to the surface and become changed into the adult form. According to Michael (1884, p. 390), the formation of this "hypopial nymph," in some forms at least, takes place quite "irrespective of adverse conditions," and only in the case of a few individuals, being "a provision of nature for the distribution of the species," in other words, simply a protective travelling dress. It would seem, however, that in the case of the "hypopial nymph" herein recorded, Mégnin's conclusions are more probable. This is, so far as I have been able to find, the first record of the existence of this form in Australia, though it is evidently well known in Europe, and is also found in the United States of America (v. Hassall).

Host.—Pigeon: in connective tissue around roots of pectoral blood vessels, and on the pericardium around entrance of inferior vena cava.

Locality.—Melbourne, Vic.; September, 1908, per Dr. T. S. Hall.

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EXPLANATION OF PLATE XXIX.

All Figures are outlined by the aid of the Camera Lucida.

Fig. 1.—*Tridontophorus intermedius*, n. sp., $\times 2$, showing proportions of animal, and female opening.

Fig. 2.—Anterior end of same, $\times 42$.

B.C. = Buccal capsule.

C.P. = Cervical papillæ.

